MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

DEE5046 – ELECTRONICS 3

(Diploma in Electronics Engineering)

15 AUGUST 2022
9:00 AM –11:00 AM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **6** pages excluding the cover page with **4** questions only.

2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 [25 marks]

(a) Refer to the Figure 1 below, answer the following:

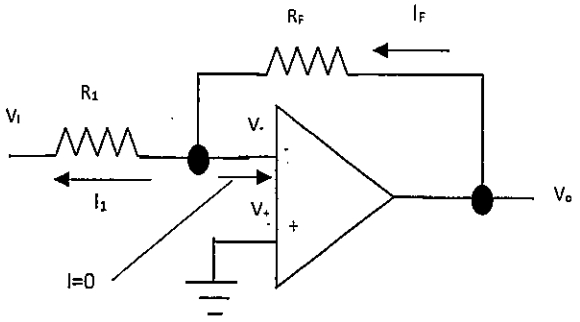

Figure 1

(i) Identify the type of the op-amp. (1 mark)
(ii) Explain the function of the op-amp based on (a)(i). (2 marks)
(iii) Interpret the term "virtual grounding" based on Figure 1. (3 marks)

(b) Refer to the Figure 2, calculate the output voltage, V_{out}. (5 marks)

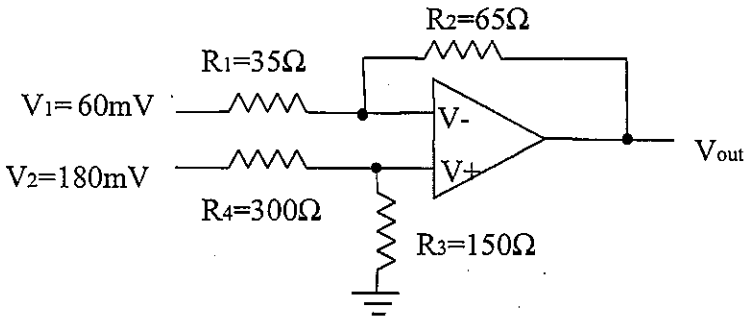

Figure 2

Continued ...

(c) Refer to the Figure 3, given that the voltage gain, $K = 2$ and $f_c = 2$ kHz. Answer the following:

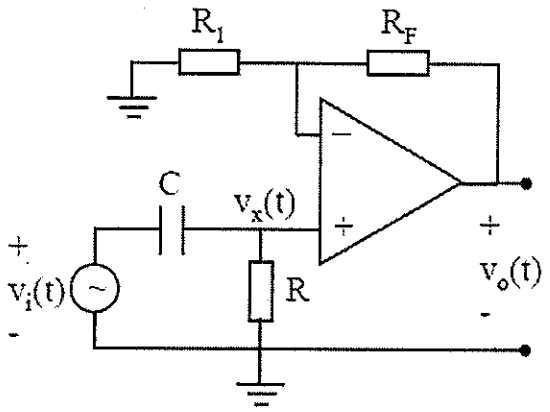

Figure 3

(i) Identify the type of the active filter. (1 mark)

(ii) Describe any **FOUR** advantages of the filter in Figure 3 compared to the passive filter. (4 marks)

(iii) Sketch the expected frequency response based on the Figure 3. (3 marks)

(iv) Assume that $R = 10$ kΩ, calculate the value of capacitor. (3 marks)

(v) Assume that $R_1 = 10$ kΩ, calculate the value of feedback resistor. (3 marks)

Continued ...

QUESTION 2 [25 marks]

(a) Interpret the following term that used in practical op-amp analysis:

(i) Thermal drift (2 marks)
(ii) Common-Mode Rejection ratio (CMRR). (2 marks)

(b) Figure 4 shows a non-inverting amplifier. Given that the $R_1 = 2.2\ k\Omega$, $R_f = 65\ k\Omega$, $V_{IO} = 8\ mV$, calculate the following:

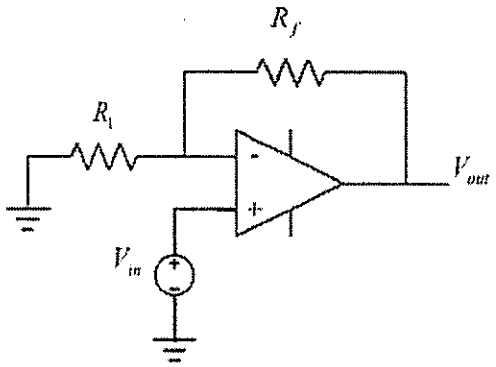

Figure 4

(i) Voltage gain, A_V (3 marks)
(ii) Output offset voltage due to input offset voltage. (3 marks)
(iii) Predict another ONE factor that also result an error of the output voltage. (1 mark)
(iv) Illustrate (in words) the reason of the factor in (iii) which will cause the error in output. (4 marks)

Continued ...

(c) Figure 5 shows a phase shift oscillator circuit which can accommodate an oscillation of 500 Hz.

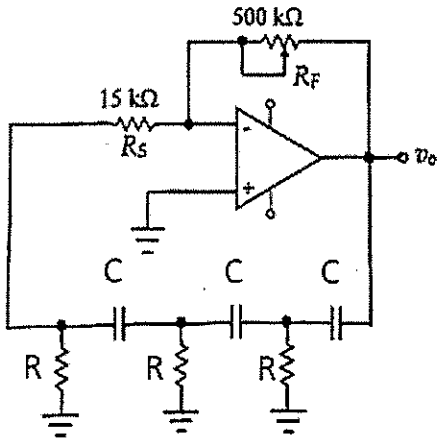

Figure 5

Based on the Figure 5, calculate the following:

(i) Resistor value in the RC circuit if C = 100 nF. (2 marks)
(ii) The value of feedback resistor, R_F that need to be adjusted by using 500 kΩ potentiometer. (2 marks)

(d) For an op-amp, an undesired electrical signal present in the output voltage is known as noise. Apply THREE solutions to minimize the output error voltage due to the noise in the op-amp itself. (6 marks)

Continued ...

QUESTION 3 [25 marks]

(a) Based on Figure 6, describe the ability of the over voltage protection circuit in aiding the voltage protection of the load connected. (10 marks)

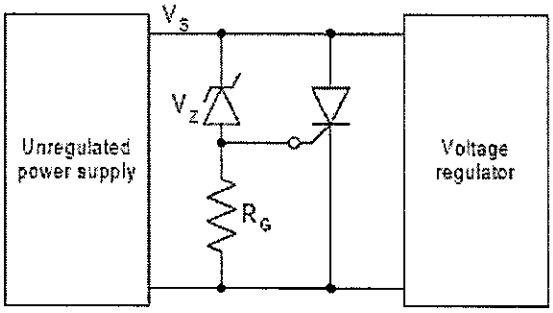

Figure 6

(b) A voltage regulator circuit has a 50V output when there is no load (I_L= 0A). When there is a full-load current of 88mA, the output voltage is 48.9V. Calculate the following:
(i) Voltage regulation as a percentage change from no-load to full-load (3 marks)
(ii) Voltage regulation as a percentage change for each mA change in the load current. (3 marks)

(c) Given a series feedback regulator in Figure 7 with R_A = 45 kΩ, R_B = 50 kΩ and Zener voltage, V_Z = 4.7 V.

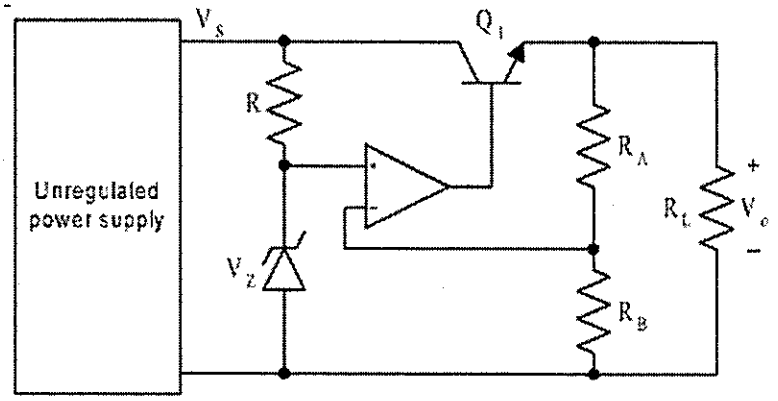

Figure 7

(i) Illustrate (by words) of a basic unregulated power supply. (4 marks)
(ii) Describe the function of the Zener diode in the series feedback regulator. (2 marks)
(iii) Calculate the output voltage. (3 marks)

Continued ...

QUESTION 4 [25 marks]

(a) Figure 8 shows an Inverting Schmitt Trigger circuit. Answer the following:

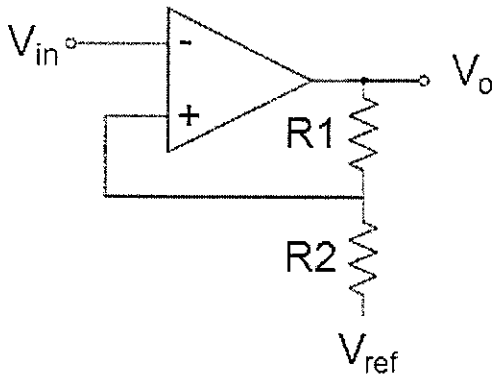

Figure 8

(i) Assume in the circuit that V_{ref} is grounded and $R_1 = R_2 = 50\ k\Omega$. Calculate the upper and lower trigger points for the circuit if $V_{out(max)} = \pm 10V$ (6 marks)

(ii) Sketch the waveform for input and output if $V_{in} = 8 \sin \omega t$ (4 marks)

(iii) Illustrate (by word) on how the Schmitt Trigger circuit in Figure 8 can be modified to allow different values of V_{UTP} and V_{LTP} by showing the mathematical expression. Then draw its circuit diagram after the modification. (10 marks)

(b) Refer to the Figure 7, answer the following:

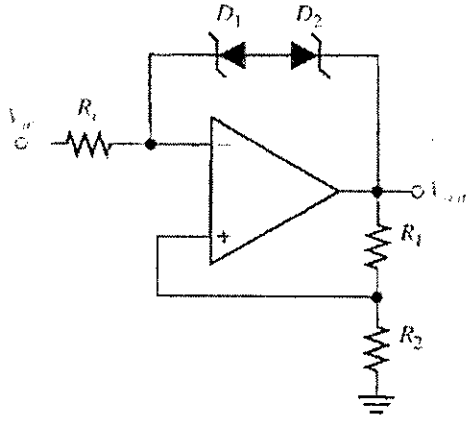

Figure 7

(i) Identify the type of the comparator. (1 mark)

(ii) Illustrate (by words) the functionality served by the Zener diode in the comparator circuit. (4 marks)

End of Page.